

# GROMA

## Programming a Permanent Multichannel Sound Installation

Martin Rumori

Klanglabor  
Academy of Media Arts Cologne

7th Linux Audio Conference  
Parma, April 19th, 2009

# *GROMA*

## Outline

- 1 Introduction
- 2 Artistic Concept of GROMA
- 3 Technical setup
- 4 Implementation

# GROMA

## Permanent Multichannel Sound Installation

- Permanent sound installation in Cologne *Rheinauhafen* area
- Combining ancient texts with environmental sounds of partner cities of Cologne
- Inaugurated in May 2008
- Done by
  - Cologne based artist Michael Scholz (idea and artistic director)
  - Judith Nordbrock (concept and sound engineering)
  - Martin Rumori (concept and programming)
  - And numerous supporters, helpers, providers, ...

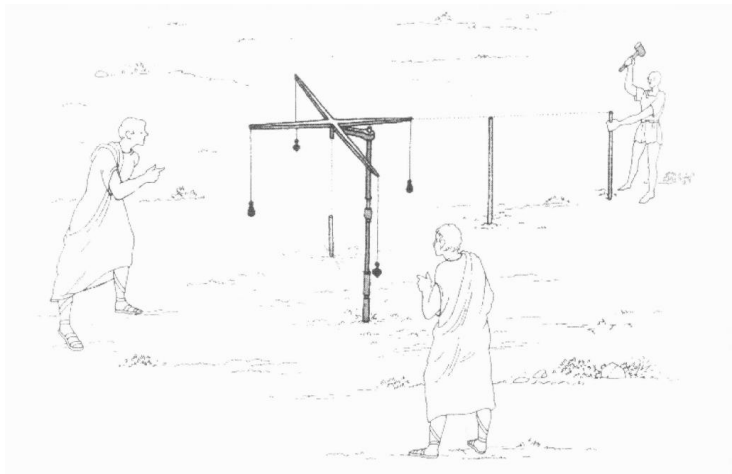
# *GROMA*

Origin of the Title

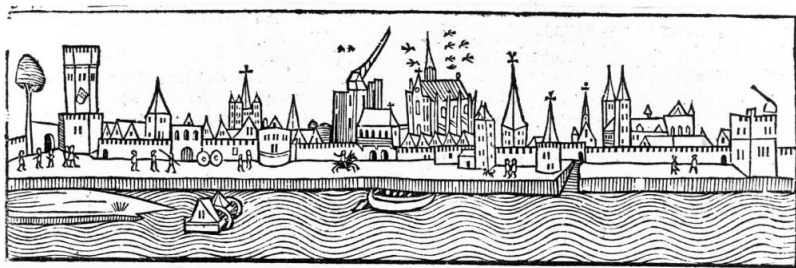
- Ancient roman measuring instrument
- Used by the so called *Agrimensors* when founding a new settlement
- In the case of Cologne: still existing historical central crossroads: *Hohe Straße* and *Schildergasse*

# *GROMA*

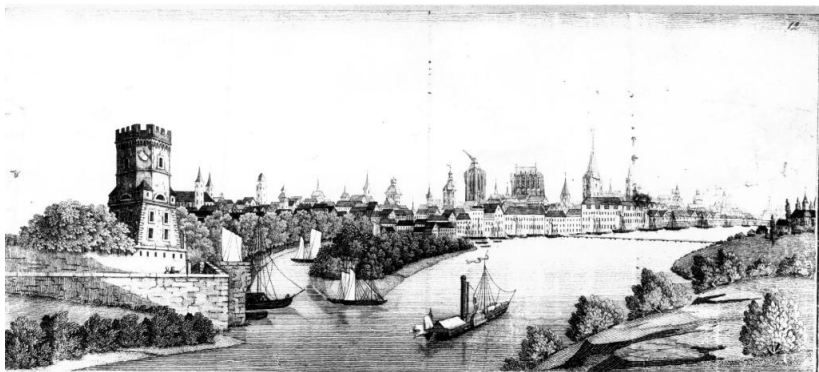
## Measuring Instrument



# Rheinauhafen



# Rheinauhafen



# Rheinauhafen



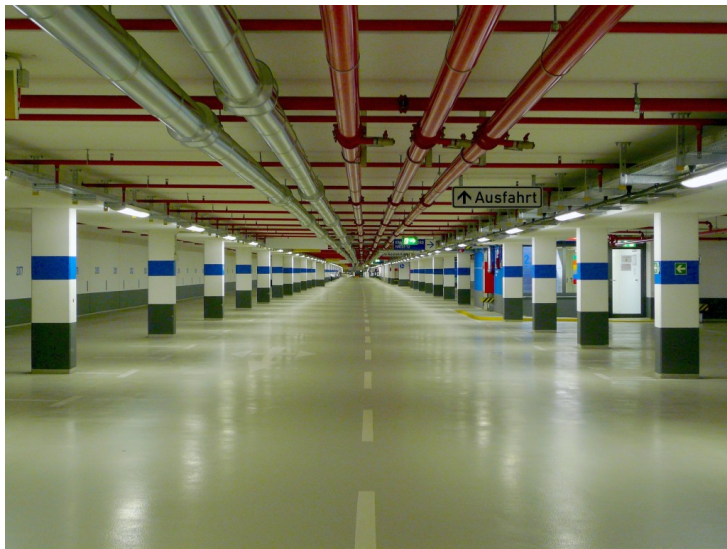


# Rheinauhafen



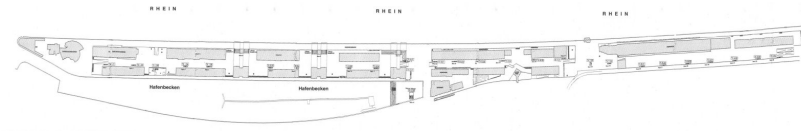
# Parking Lot

Underneath Rheinauhafen



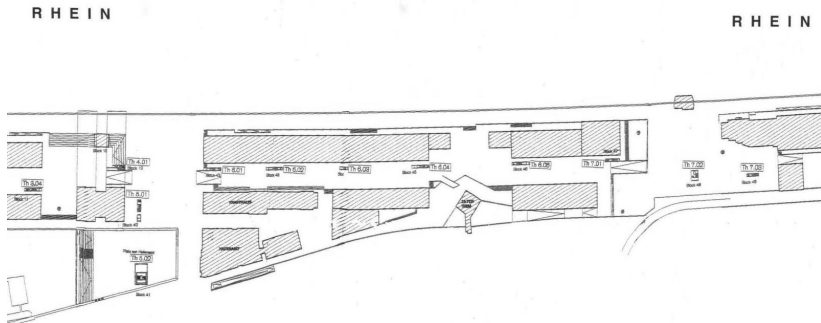
# Parking Lot

## Underneath Rheinauhafen



# Parking Lot

## Underneath Rheinauhafen



# Staircase

TR 5.02



# Staircase



# GROMA

## Basic Idea

- Environmental sound situations of partner cities of Cologne
- Two staircases (currently), corresponding to sounds from
  - TR 5.02: Rotterdam (Netherlands)
  - TR 7.02: Liège (Belgium)
- Combined with ancient texts
  - Roman antiquity, for example *Ten Books on Architecture* by *Vitruvius*
  - Texts from Ancient Greece, such as *Plato*
  - Even older texts, for example from Ancient Near East

# *GROMA*

## Compositional Idea

- Location-specific installation
- Multichannel sound projection
  - 12 channels for TR 5.02 (Rotterdam)
  - 8 channels for TR 7.02 (Liège)
- Permanent installation in a recent urban development area
- automatic/algorithmic arrangement of score elements



# *GROMA*

Recording Text Files: Traugott Buhre



# *GROMA*

## Recording Environmental Sounds: Rotterdam Europort



# *GROMA*

## Recording Equipment

- Schoeps M/S Set
- Sanken CSS-5
- Binaural Microphones (OKM)
- Hydrophone DPA 8010 and DPA 8011
- Accelerometer Brüel and Kjær 4370
- DAT Recorders, Sounddevices Solid State Recorders

# *GROMA*

## Recording Environmental Sounds: Aquarium



# GROMA

## Catalogue of Recordings

Finder Abfolge Bearbeiten Darstellung Gehe zu Fenster Hilfe										
LUE_JU_Final_161107.xls										
	A	B	C	D	E	F	G	H	I	J
	FILE Name	OUTFILE Name	ORT Name	ORT_Thema	ION_Beschreibung	SK	SK_Beschreibung	I_Kat		Z
1	LUE_DA_MS_030207_T011		VIVGONS/CANAL ALBERT	Fussballspiel Kinder	Mitte Rechts vom Feld		Amateurfussball	KUR.05		
2	LUE_DA_MS_030207_T012		VIVGONS/CANAL ALBERT	Fussballspiel Kinder	Position von Judith, Flatterecho		Amateurfussball	KUR.05		
3	LUE_JU_XY_050207_D003		VIVGONS/CANAL ALBERT	Fussballspiel Kinder	Speilbogen, Kinder Kanal im Hintergrund, Schiff fährt vorbei, MONDO		Amateurfussball	KUR.05		
4	LUE_JU_XY_050207_D004		VIVGONS/CANAL ALBERT	Fussballspiel Kinder	Spiel der Kinder, MONDO, Basse rausgeflüht		Amateurfussball	KUR.05		
5		LUE_KI_KUR_001								
6	LUE_DA_HYD_150207_T156		AQUARIUM_MUSEE ZOOLOGIQUE	Aquarium	Becken A Kiefer-Knack-Sprache eines Fisches	KI	Aquarium	KUR.01		
7	LUE_DA_HYD_150207_T157	XXX	AQUARIUM_MUSEE ZOOLOGIQUE	Aquarium	Becken B-Merous-Gewässer, haarschächtlich Pumpe	KI	Aquarium	KUR.01		
8	LUE_DA_HYD_150207_T158		AQUARIUM_MUSEE ZOOLOGIQUE	Aquarium	Becken C	KI	Aquarium	KUR.01		
9	LUE_DA_MS_150207_T154		AQUARIUM_MUSEE ZOOLOGIQUE	Aquarium	Raum 1: Haifischbecken	KI	Aquarium	KUR.01		
10	LUE_DA_MS_150207_T155		AQUARIUM_MUSEE ZOOLOGIQUE	Aquarium	Raum 2: Rundgang, Führung, alle übrigen Aquarien	KI	Aquarium	KUR.01		
11	LUE_DA_MS_150207_T160		AQUARIUM_MUSEE ZOOLOGIQUE	Aquarium	Personalbereich, Beckenzugang 1.1	KI	Aquarium	KUR.01		
12	LUE_DA_MS_150207_T161		AQUARIUM_MUSEE ZOOLOGIQUE	Aquarium	Personalbereich, Beckenzugang 1.2	KI	Aquarium	KUR.01		
13	LUE_DA_MS_150207_T162		AQUARIUM_MUSEE ZOOLOGIQUE	Aquarium	Personalbereich, Beckenzugang 2	KI	Aquarium	KUR.01		
14		LUE_KI_KUR_002								
15	LUE_DA_MS_170307_T026		ISOUS PL. ST.LAMBERT	Archeoforum	einmal Türschlagen, auf Höhe des Bushaltes kann man in das Archeoforum und dort un	KI	Archeoforum	KUR.08		
16	LUE_DA_MS_170307_T029		ISOUS PL. ST.LAMBERT	Archeoforum	Führung - Adrien-Flügel, ich bin mit der Gruppe durch die unterirdischen Gänge mitgegangen	KI	Archeoforum	KUR.08		
17	LUE_DA_MS_170307_T031	XXX	ISOUS PL. ST.LAMBERT	Archeoforum	Führung, Mikro unter Metallst-Slog versteckt	KI	Archeoforum	KUR.08		
18	LUE_DA_MS_170307_T032		ISOUS PL. ST.LAMBERT	Archeoforum	Führung, Ausgang	KI	Archeoforum	KUR.08		
19		LUE_KI_KUR_003								
20	LUE_DA_MS_150207_T149		RUE GRETRY	Bankautomat	Geld ziehen, Michael, dann ich Bankautomat	KI	Rue Gretry Bankautomat	WRK.09		
21		LUE_KI_WIR_004								
22	LUE_DA_MS_030207_T019		BLVD. DE L'EST	Zentrum von Outremouse	Kreisverkehr, singende Mädchen, Frittenbude	KI	BLVD. DE L'EST	OKB.02		
23		LUE_KI_OER_005								
24	LUE_DA_MS_150207_T130	XXX	(Fahrt zu) LYCEE LEONIE DE WAHIA	Ausfahrt	Ausfahrt mit offenem Fenster 1	KI	Boulevard d'Amoy I	OER.01		
25	LUE_DA_MS_150207_T131		(Fahrt zu) LYCEE LEONIE DE WAHIA	Ausfahrt	Ausfahrt mit offenem Fenster 2	KI	Boulevard d'Amoy I	OER.01		
26		LUE_KI_OER_006								
27	LUE_DA_MS_150207_T142		LYCEE LEONIE DE WAHIA	Ampel vor Schule	Ampel Tackern, über die Strasse in 2 Zügen, danach Ampel-Tackern ersterste, Ampel druck	KI	Boulevard d'Amoy II	OER.02		
28	LUE_DA_MS_150207_T143		BLVD. D'AVROY	Verkehr/Platzname	Atmo zwischen den beiden Blvd. Strassen	KI	Boulevard d'Amoy II	OER.02		
29		LUE_KI_OER_007								
30	LUE_DA_MS_150207_T144		BLVD. D'AVROY	Gängegehege	Gänge schnattern, sehr nah - entfernt	KI	Boulevard d'Amoy III	NAR.05		
31	LUE_DA_MS_150207_T145		BLVD. D'AVROY	Gängegehege	Gänge leise, Enten flattern weg	KI	Boulevard d'Amoy III	NAR.05		
32		LUE_KI_NAR_008								
33	LUE_DA_MS_070207_T026A		CAFÉ RANDAXHE	Kunstterrace	Atmo von Café, viel Bohemascine	KI	Café Randaxhe	OKB.03		
34		LUE_KI_OER_009								
35	LUE_DA_MS_030207_T013	XXX	COCKERILL/CANAL ALBERT	Uferseite Vivigons	Tanker von rechts, 02-55 Klettverschluss	KI	Canal Albert	STL.08		
36	LUE_DA_MS_030207_T014		COCKERILL/CANAL ALBERT	Uferseite Vivigons	Kütlern von links	KI	Canal Albert	STL.08		
37	LUE_DA_MS_030207_T015		COCKERILL/CANAL ALBERT	Uferseite Vivigons	angeläut, 3 Tanker von links	KI	Canal Albert	STL.08		
38	LUE_DA_MS_030207_T016		COCKERILL/CANAL ALBERT	Uferseite Vivigons	zwischen Spundwand und Schiff 1	KI	Canal Albert	STL.08		
39	LUE_DA_MS_030207_T017		COCKERILL/CANAL ALBERT	Uferseite Vivigons	zwischen Spundwand und Schiff 2	KI	Canal Albert	STL.08		
40	LUE_JU_HYD_090207_D000		COCKERILL/CANAL ALBERT	im Kanal Albert	Zwei vorbeifahrende unterschiedlich große Schiffe	KI	Canal Albert	STL.08		
41	LUE_JU_KON_090207_D000		COCKERILL/CANAL ALBERT	Anglegies Schiff Kanal Albert	Kontaktkontrolle an Position 1 am Schiff, bass weg	KI	Canal Albert	STL.08		
42	LUE_JU_KON_090207_D001		COCKERILL/CANAL ALBERT	Anglegies Schiff Kanal Albert	Kontaktkontrolle an Position 2 am Schiff, bass weg	KI	Canal Albert	STL.08		
43	LUE_JU_KON_090207_D002		COCKERILL/CANAL ALBERT	Anglegies Schiff Kanal Albert	Kontaktkontrolle an Position 3 am Schiff, bass weg Schiff fährt vorbei	KI	Canal Albert	STL.08		
44		LUE_KI_STI_010								
45	LUE_DA_MS_140307_T032		CENTRE COMM. BELLE ILE	Einkaufszentrum 1	Gang/Rolltreppe, Hauptthale	KI	Centre Comm. Belle Ile	WRK.05		
46	LUE_DA_MS_140307_T033	XXX	CENTRE COMM. BELLE ILE	Einkaufszentrum 1	Gang Supermarkt, viel Mikro-/Taucherglocke und Musik	KI	Centre Comm. Belle Ile	WRK.05		
47	LUE_DA_MS_140307_T034	XXX	CENTRE COMM. BELLE ILE	Einkaufszentrum 1	Gang/Positionwechsel von Kanal 1.2 zurück zu 1.1, Ladenschluss	KI	Centre Comm. Belle Ile	WRK.05		
48	LUE_DA_MS_140307_T035		CENTRE COMM. BELLE ILE	Einkaufszentrum 1	Tiefgarage, Beschallung aus, Schritte, Autos (mit Musik)	KI	Centre Comm. Belle Ile	WRK.05		
49	LUE_KI_OCMK_040307_D001		CENTRE COMM. BELLE ILE	Einkaufszentrum 1	Einkaufswagen nehmen, mono/rechter Kanal	KI	Centre Comm. Belle Ile	WRK.05		
50	LUE_KI_OCMK_040307_D002		CENTRE COMM. BELLE ILE	Einkaufszentrum 1	Durchsage 2, mono/rechter Kanal	KI	Centre Comm. Belle Ile	WRK.05		
51	LUE_KI_OCMK_040307_D003		CENTRE COMM. BELLE ILE	Einkaufszentrum 1	Soswamen, mono/rechter Kanal	KI	Centre Comm. Belle Ile	WRK.05		
52	LUE_KI_OCMK_040307_D004		CENTRE COMM. BELLE ILE	Einkaufszentrum 1	Durchsage 3, 4, mono/rechter Kanal	KI	Centre Comm. Belle Ile	WRK.05		
53	LUE_KI_OCMK_040307_D005		CENTRE COMM. BELLE ILE	Einkaufszentrum 1	Baby jammert, mono/rechter Kanal	KI	Centre Comm. Belle Ile	WRK.05		
54	LUE_KI_OCMK_040307_D006		CENTRE COMM. BELLE ILE	Einkaufszentrum 1	Nähe Bootschleuse 1, mono/rechter Kanal	KI	Centre Comm. Belle Ile	WRK.05		
55	LUE_KI_OCMK_040307_D007	XXX	CENTRE COMM. BELLE ILE	Einkaufszentrum 1	Nähe Bootschleuse 2, Michael Fragen, mono/rechter Kanal	KI	Centre Comm. Belle Ile	WRK.05		
56	LUE_KI_OCMK_040307_D008		CENTRE COMM. BELLE ILE	Einkaufszentrum 1	Stapler/Stapelwagen, mono/rechter Kanal	KI	Centre Comm. Belle Ile	WRK.05		
57	LUE_KI_OCMK_040307_D009		CENTRE COMM. BELLE ILE	Einkaufszentrum 1	Durchsage 5, 6, mono/rechter Kanal	KI	Centre Comm. Belle Ile	WRK.05		
58	LUE_KI_OCMK_040307_D010	XXX	CENTRE COMM. BELLE ILE	Einkaufszentrum 1	Wagen, Durchsage 7, mono/rechter Kanal	KI	Centre Comm. Belle Ile	WRK.05		
59	LUE_KI_OCMK_040307_D011		CENTRE COMM. BELLE ILE	Einkaufszentrum 1	Kassensbereich, mono/rechter Kanal	KI	Centre Comm. Belle Ile	WRK.05		
60	LUE_KI_OCMK_040307_D012		CENTRE COMM. BELLE ILE	Einkaufszentrum 1	Pos. Supermarkt bis Hauptthale, mono/rechter Kanal	KI	Centre Comm. Belle Ile	WRK.05		
61	LUE_KI_OCMK_040307_D013		CENTRE COMM. BELLE ILE	Einkaufszentrum 1	Scheibemäuser zur Parkgarage, mono/rechter Kanal	KI	Centre Comm. Belle Ile	WRK.05		
62		LUE_KI_WIR_011								
63	LUE_DA_MS_130207_T079		ST. LAMBERT	Einkauf-Arkaden	Atmo, Rundgang, Rolltreppe	KI	Einkaufszentrum St. Lambert I	WRK.05		
64	LUE_KI_OCMK_130207_D003		ST. LAMBERT	Einkauf-Arkaden	OCMK Atmo, Rundgang, Rolltreppe, linker Kanal, defekt nicht nutzbar	KI	Einkaufszentrum St. Lambert I	WRK.05		
65		LUE_KI_WIR_012								
66	LUE_DA_HYD_130207_T110		COCKERILL SERAING	Erfzfrachter »ATINA« entladen	Hydrophon an Heck, Seitenarm, Heck	KI	Erfzfrachter entladen	WRK.04		
67	LUE_DA_HYD_130207_T111		COCKERILL SERAING	Erfzfrachter »ATINA« entladen	Erfzfrachter Schiff weit ab	KI	Erfzfrachter entladen	WRK.04		
68	LUE_DA_HYD_130207_T108		COCKERILL SERAING	Erfzfrachter »ATINA« entladen	am Heck, ohne Anker	KI	Erfzfrachter entladen	WRK.04		

# *GROMA*

## How to Organise the Sounds?

- Permanent installation
- Public space
- Commercial and residential neighbourhood
- Regular and occasional passers-by

# *GROMA*

## Development of the Score

- Sounds are categorised according to *urban functions*
  - Public space
  - Urban infrastructure
  - Nature space
  - Economic space
  - ... (7 categories in total, plus subcategories)
- Category associations for texts
- Define score elements
  - *Texte* (texts)
  - *Klanginseln* (“sound isles”): stereophonic, seamlessly loopable
  - *Trajekte* (“trajectories”): full channel, static compositions
  - *Schlagwörter* (“keywords”): text fragments

# *GROMA*

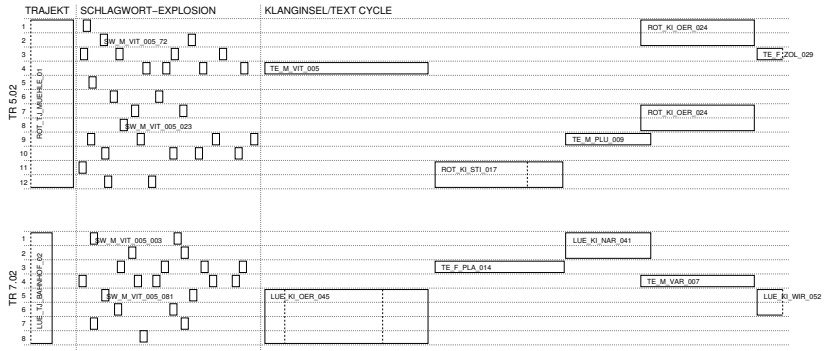
## Temporal Unfolding of the Score

- Two major score states
  - Cycle of texts and *Klanginseln*  
strict algorithmic rules, but most variable in actual appearance
  - *Trajekte*  
fixed, static multichannel compositions, narrative structure
- Transition between the two states:
  - *Schlagwort-Explosion* (“keyword explosion”)
  - Reflects fragments of most recently played text or following text
  - Transition from “organised” to “chaotic” and vice versa
  - Affects ordering and spatial position of text fragments



# GROMA

## Synthetic Example Score



# *GROMA*

## Technical Setup

- 2 PC computers running 64Studio (2.x)
- RME Audio Cards, ADAT to analogue converters, multichannel amplifiers
- Optical network connection due to distance
- Racks on wheels, all pluggable connections:
  - High water risk
  - Parking lot is constructed for being flooded
- Speakers: custom design (colour issues, robust, ...)

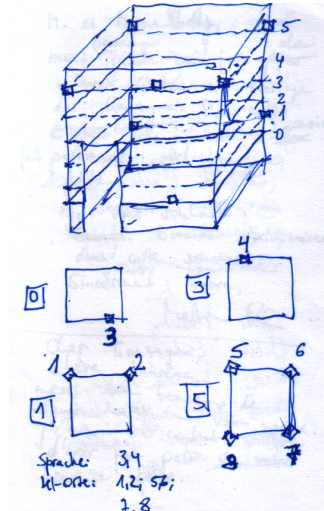
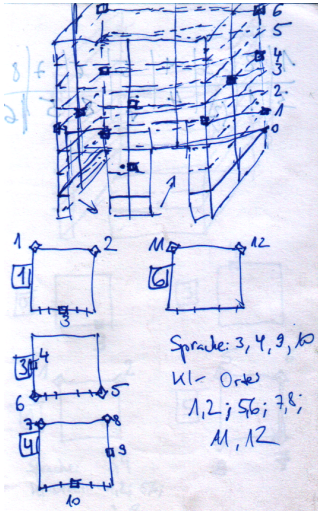
# *GROMA*

Rack in TR 7.02



# GROMA

## Speaker Layout



*GROMA*

Speaker by Audiance® <http://www.audiance.net>



# *GROMA*

## Software Implementation Requirements

- Permanent installation: reliable and stable
- Site-specific installation: fine tuning is only possible on-site
- Flexibility for fine tuning and changes

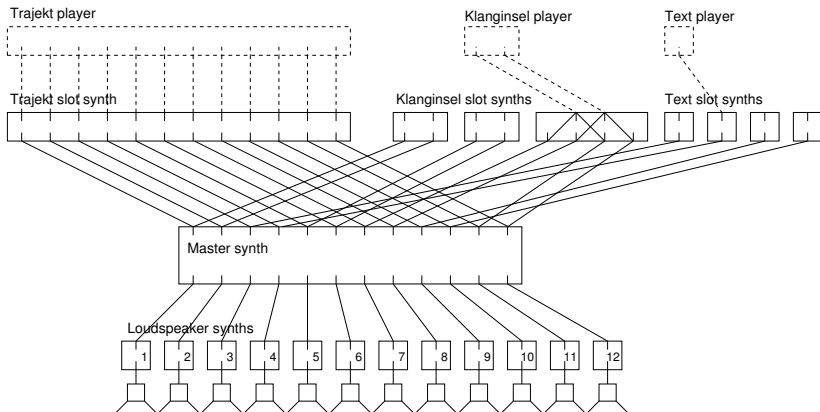
# *GROMA*

## Implementation Details

- Supercollider: stable, flexible, performant
- Text-based, high level, object oriented language
- → easy implementation of algorithmic score rules
- Site-specific installation:  
setup, corrections, fine tuning have to be done on-site
- ... possibly in winter ...
- Implementation needs to provide flexibility for fine tuning and changes
- → versatile routing system corresponding to score elements

# *GROMA*

## Routing System





- Routing
- Signal processing: gain, filtering, ...
- Dynamically adjustable and exchangeable at runtime
- Settings of the synth graph can be saved and restored
- Example: simple gain adjusting loudspeaker slot synth

```
SynthDef('gr_speaker_std', {  
    arg gain, out, in;  
  
    Out.ar(out, gain * In.ar(in, 1));  
}).writeDefFile;
```

### ■ More complex example: text slot synth with deesser

```
SynthDef('gr_slot_te_deesser', {  
  arg gain, out, in,  
  matrix = #[ 0, 0, 0, 0, 0, 0, 0, 0, 0,  
             0, 0, 0, 0, 0, 0, 0, 0 ],  
  preGain = 1.0, sideGain = 1.0,  
  sideFreq = 5000, compThresh = 0.5,  
  compRatio = 0.25, compAttack = 0.002,  
  compRelease = 0.01;  
  
  Out.ar(out, matrix * Comander.ar(  
    in: preGain * In.ar(in, 1),  
    control: HPF.ar(In.ar(in, 1),  
      sideFreq, sideGain),  
    thresh: compThresh, slopeBelow: 1.0,  
    slopeAbove: compRatio,  
    clampTime: compAttack,  
    relaxTime: compRelease,  
    mul: gain));  
}).writeDefFile;
```

# *GROMA*

## Soundfile Playback

- GrTrack and GrPlay classes
- Based on DiskIn unit generator, extended by a looping function
- play method provides database lookup for soundfile class, available slots, duration, ...

```
play { arg name, slot = 0, start = 0.0,  
      env = nil, duration = nil,  
      fadeTime = 0.1, loop = 0, run = true,  
      action = nil;
```

...

# *GROMA*

## Score Implementation

- Score rules implemented using *Patterns* and *Streams*
- Algorithmic series of soundfiles
- Weighted random functions for selection processes
- *Schlagwort-Explosion*
  - Two streams: one organised, one chaotic stream of text fragments
  - random selection with gradually changing weight

# *GROMA*

## Realtime Score vs. Pregenerated Score

- Realtime score implementation possible and easy
- ..., as long as there is only one machine!
- Synchronisation issues are non-trivial
- → pregenerated score
- conceptually (maybe) different, phenomenologically ...  
probably not too much ...
- Eternity?

# GROMA

```

emacs@gromal (
// GROMA
// permanent sound installation
// rheinhafen cologne

// michael scholz, judith nordbrock, martin rukori
// code by martin rukori

( // start this block to prepare
var site;

site = "ROT"; // for Rotterdam
// site = "LUE"; // for Luettich

// set soundcard to waster
"/usr/bin/amixer -c 1 set Sync\\ Mode Master",unixCmd;

s.waitForBoot({
r = GrRouting.new(s, c = GrSynthConfig.load("synthconfig_" + site + ".grcfg"));
p = GrPlay.new(r, d = GrSndConfig.load("sndconfig.grcfg"));
d.prefix("~/groma/snd/GROMA_SND_FLAT",standardizePath);
j = GrScorePlay.new(site.asSymbol, delta: 0, player: p);
k = GrVolumeControl.new(r);
"GROMA ready.".postln;

-- groma.sc (SCLang)--L1--C0--Top
GrPlay: track_finished: TE_M_VIT_005 (nodeID 37059)
GrPlay: track_started: ROT_K1_S11_014 (nodeID 37060)
GrPlay: track_finished: ROT_K1_S11_014 (nodeID 37060)
GrPlay: track_started: TE_M_NEH_053 (nodeID 37061)

localhost (127.0.0.1) 23.6123.9 % u: 2310 s: 63 e: 12 d: 51

732 root 15 -b 0 0 0 S 0 0.0 54:25.92 IRQ-21
960 root -86 -5 0 0 0 S 0 0.0 54:25.92 IRQ-21
5123 groma 20 0 16832 12w 4164 S 0 1.3 92:38.94 ewacs
27187 groma 20 0 7636 2372 2176 S 0 0.3 0:00.06 xterm
1 root 20 0 1948 656 564 S 0 0.1 0:23.79 init
2 root RT 0 0 0 0 S 0 0.0 0:00.06 migration/0
3 root RT 0 0 0 0 S 0 0.0 0:00.00 posix_cpu_timer
4 root -51 0 0 0 0 S 0 0.0 0:00.00 softirq-high/0
5 root -51 0 0 0 0 S 0 0.0 47:11.17 softirq-timer/0
6 root -51 0 0 0 0 S 0 0.0 0:00.00 softirq-net-tx/
7 root -51 0 0 0 0 S 0 0.0 0:10.67 softirq-net-rx/

groma@gromal:~$ uptime
17:15:03 up 30 days, 14:19, 2 users, load average: 1.24, 0.86, 0.80
groma@gromal:~$ date
Tue Oct 24 17:15:15 CEST 2008
groma@gromal:~$
groma@gromal:~$ xtrlock &
[1] 27246
groma@gromal:~$

```

*THANK YOU!*

<http://www.groma-net.de>

